Space Weather Technical Forecast

Issued on Saturday, 29 June 2024 at 01:18 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares throughout. G1/Minor Storm intervals likely Day 1 (29 Jun), risk declining next few days.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: There are currently thirteen regions on the disc, but with most of these regions small and simple. AR3729 and AR3719 are the two largest regions on the disc, but both appear fairly straightforward magnetically, although AR3719 has shown a recent increase in its trailing spots. There are a series of regions in the solar southern hemisphere, all of which individually are fairly straightforward, but their proximity to each other and SDO imagery suggests the potential for magnetic interaction between them. There is a new region rotating onto the northeast limb, which is more than likely not yet fully visible.

No new Earth-directed CMEs have been observed in coronagraph imagery in the past 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds observed by ACE at L1 showed a CME arrival at 28/0910 UTC. Initially background wind speeds jumped as the CME arrived to slightly elevated levels, increasing gradually after the arrival to vary between 450-490 km/s. Density was average for much of the period but reached above average at times mainly between 28/0910-1650 UTC, peaking well above average at 72 ppcc. The Interplanetary Magnetic Field, Bt, was mostly moderate, but became strong at times between 28/0910-1630 UTC, peaking at 30nT. The north-south component, Bz, became strongly southward directed with a peak of -25nT after the CME arrival, becoming more variable after 28/1100 UTC. Phi angle was predominately negative (towards the Sun), becoming variable after 28/1050 UTC. Geomagnetic activity was Active (Kp 4), increasing to reach G4/Severe Storm (Kp 8) between 28/1200-1500 UTC, before easing to Unsettled (Kp 3) by 29/0000 UTC.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES18 remained at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was at background levels. The 24-hour fluence remained below Active, with 1.0e6 integrated pfu observed at 29/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected with a chance of isolated M-flares.

Solar Wind / Geomagnetic Activity: A CME arrived at Earth at 28/0910 UTC, with waning CME effects expected to continue into Day 1 (29 Jun). In addition, a faint and weak CME which left the Sun on 25 June is thought to be Earth directed, most likely arriving during Day 1, but with uncertainty in timing. A CME which left the Sun on 27 June has a slight chance of a glancing blow during Day 2 (30 Jun) but this is low confidence. There are no coronal holes on the disc to give any fast wind influence.

Geomagnetic activity is expected to be Unsettled to G1/Minor Storm (Kp 3-5) on Day 1 with a slight chance of further G2/Moderate Storm (Kp 6) intervals, both due to the current CME effects and due to the likely arrival of the weak CME from 25 June. Conditions are then expected to become Quiet to Unsettled during Day 2, but with a slight chance of further Active to G1/Minor Storm intervals should a glancing blow from the 27 June CME occur.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at background levels. However, there is a very slight chance of exceeding the S1/Minor Storm

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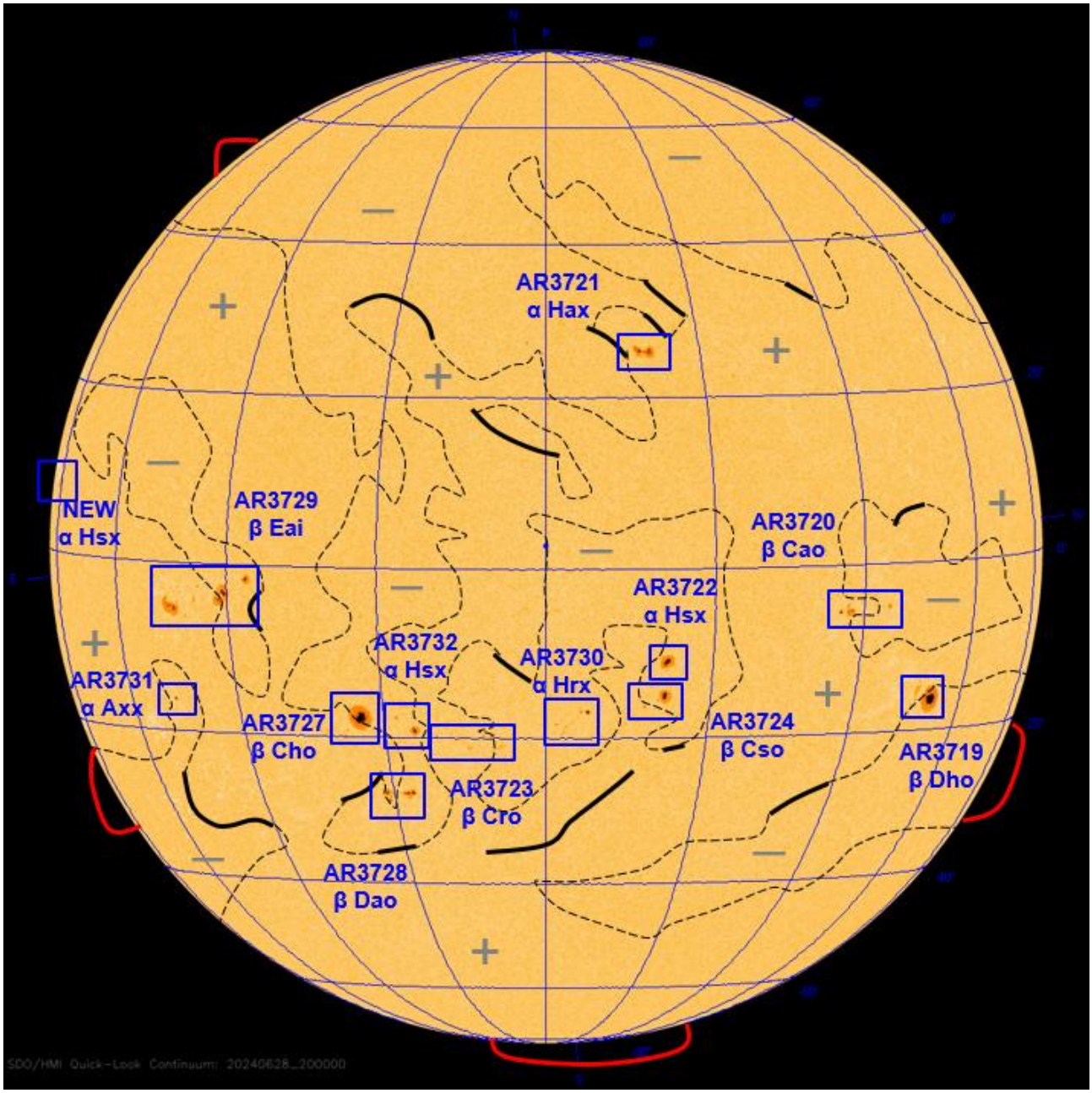
threshold should any notable flares occur. High energy electron flux might show an increasing trend in the next few days after the recent CME influence. The associated 24-hour fluence is likely to remain below the Active threshold, but with a slight chance of exceeding later in the period.

Figure 1. Solar Analysis Valid 28/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME which left the Sun on the 25 June, associated with a filament eruption off the southwest quadrant, arrived at Earth at 28/0910 UTC, with waning CME effects expected to continue into Day 1 (29 Jun). In addition, a CME which left the Sun on 25 June from AR3720 is thought to be Earth directed, most likely arriving during Day 1, but with uncertainty in timing. This was a faint and likely weak CME, but if it arrives when the current CME effects are still ongoing it could prolong the current activity. A further CME which left the Sun on 27 June has a slight chance of a glancing blow during Day 2 (30 Jun) but this is low confidence. There are no coronal holes on the disc to give any fast wind influence.

Geomagnetic activity is expected to be Unsettled to G1/Minor Storm (Kp 3-5) on Day 1 with a slight chance of further G2/Moderate Storm (Kp 6) intervals, both due to the current CME effects and due to the likely arrival of the weak CME from 25 June. Conditions are then expected to become Quiet to Unsettled during Day 2, but with a slight chance of further Active to G1/Minor Storm intervals should a glancing blow from the 27 June CME occur.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	60	20	5	1
Strong	G3	Yes	1	1	1	1
Severe	G4	Yes	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
26/0701	Partial	AR3720 + Filament	S-Centre	400 km/s	29/1200 UTC +/- 12 hours	Only weak impact likely
28/0200	Partial	AR3719	SW	390 km/s	30/0600 UTC +/- 9 hours	Glancing blow possible

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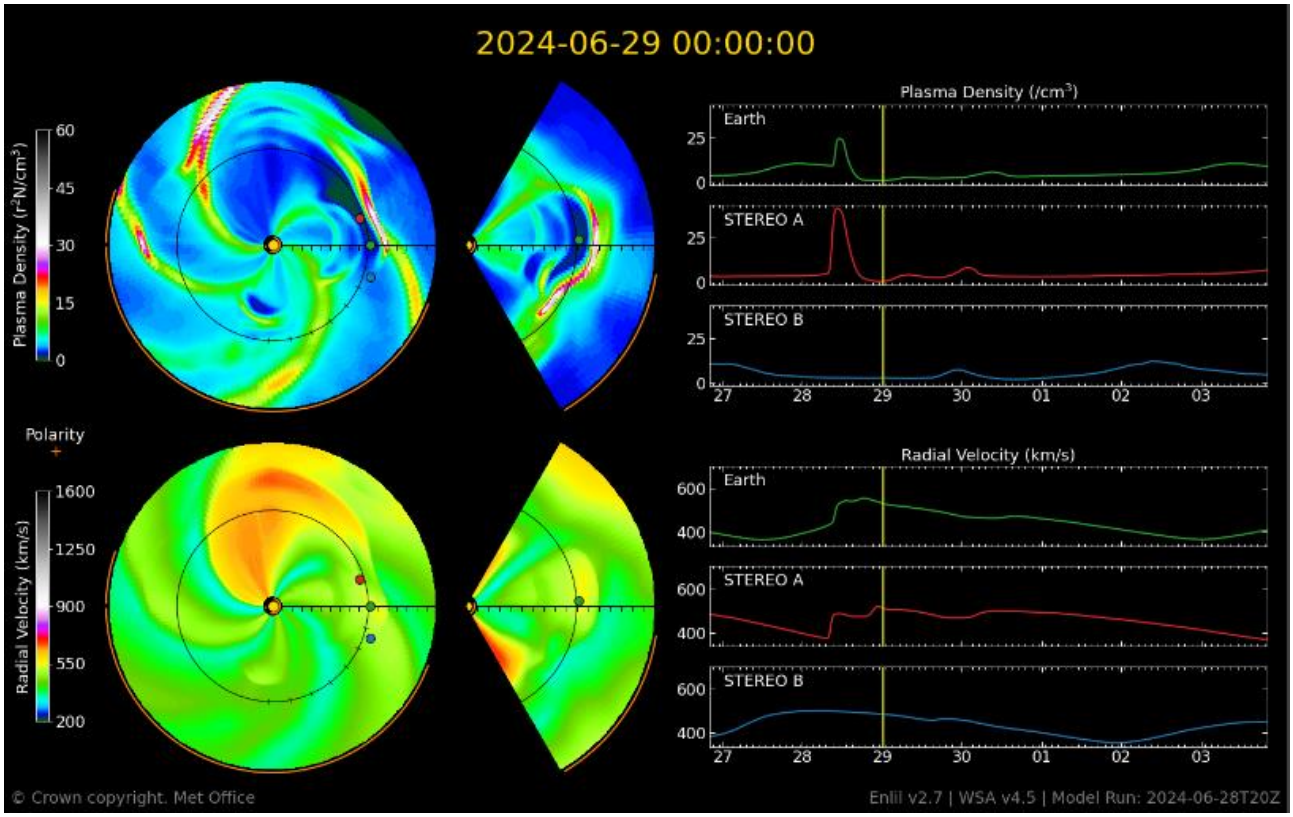
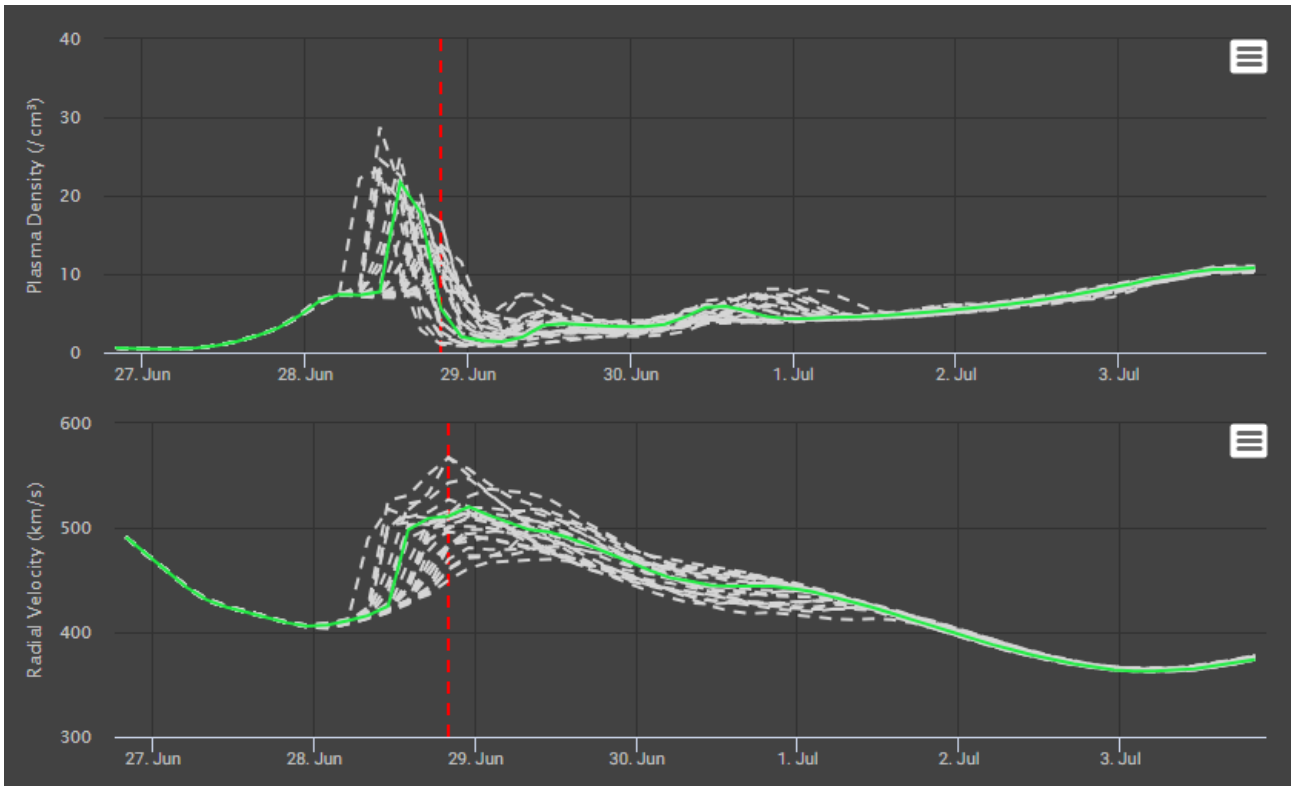
Figure 2: MOSWOC Enlil and ensemble showing potential CME arrivals the next couple of days.





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Radio Blackouts - X-Ray Flares:
There are currently thirteen regions on the disc, but with most of these regions small and simple. AR3729 (Eai/Beta) and AR3719 (Dho/Beta) are the two largest regions on the disc, but both appear fairly straightforward magnetically, although AR3719 has shown a recent increase in its trailing spots. There are a series of regions in the solar southern hemisphere, all of which individually are fairly straightforward, but their proximity to each other and SDO imagery suggests the potential for magnetic interaction between them. There is a new region rotating onto the northeast limb, which is more than likely not yet fully visible.

Far side sounding data and persistence suggest the potential for further regions to rotate around the eastern limb during the period, with AR3719 rotating off late on Day 3 (01 Jul) and AR3720 during Day 4 (02 Jul). Given that each region is only contributing a small amount to the overall flare risk, a chance of isolated M-class flares is maintained throughout the period, with a very slight chance of isolated X-class flares.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: X-ray flux at GOES16 and 18, showing only minor C-class flares in the last 24 hours.

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Solar Radiation Storms - (High Energy Protons):
High energy proton flux, as measured by GOES-18, is most likely to remain at background levels. The numerous sunspots on the Earth-facing disc are mostly fairly simple and stable, so thought unlikely to produce the significant flares that would lead to observed proton flux at GOES rising.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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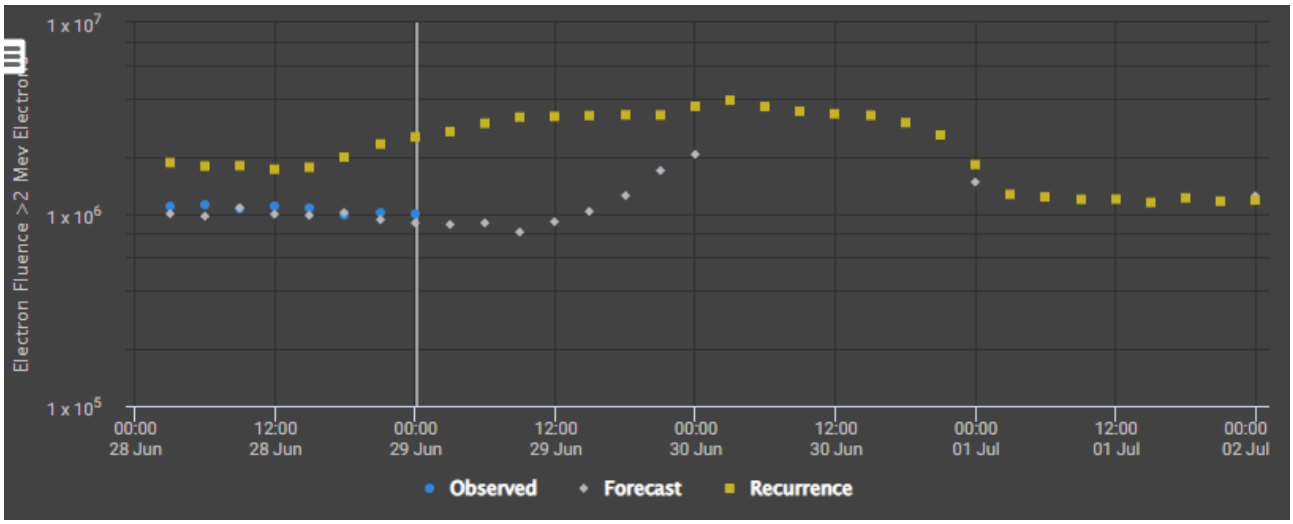
High Energy Electrons Event (≥ 2MeV):
High energy electron flux, as observed by GOES-16, is expected to continue at background levels for the start of the period. The recent CME enhancement may have caused an increase in electron flux below GEO, but the potential for further CME arrivals could suppress this once again. Overall, electron flux is most likely to stay at background levels, but as the solar wind speeds decline there is the possibility of an increase to peak at moderate or perhaps high levels later in the period.

Associated electron fluence is most likely to persist below the Active threshold (1e8 integrated pfu), but with a slight chance of an increase above Active later in the period. MOSWOC REFM is forecasting below Active through the next three days, which is the most probable outcome.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM showing a below Active forecast, which is the most probable outcome.



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